

Remarks

Further and favorable reconsideration is respectfully requested in view of the foregoing amendments and following remarks.

Thus, claim 1 has been amended to recite that pitch-based carbon fiber mat contains at least 30 wt.% of carbon fibers having a fiber length of at least 100 mm, which corresponds to the feature at the beginning of claim 3.

Claim 9 has been amended in response to the rejection of this claim under the second paragraph of 35 U.S.C. §112, rendering this rejection moot as applied to claim 9.

The rejection of claims 1-3 and 5 under the second paragraph of 35 U.S.C. §112 is respectfully traversed.

The Examiner refers to MPEP 2173.05(d) as a basis for this rejection. This section of the MPEP appears to object to a term indicating subjective preference in a claim.

However, the term "preferentially aligned in one direction" or "preferential alignment" in claim 1 is used to indicate an objective distinction from "random alignment" of carbon fibers. Moreover, the preferential alignment of carbon fibers recited in claim 1 can be easily confirmed objectively by visual observation or electrical resistance measurement as recited in claim 2. Thus, the objective use of "preferential(ly)" as in the present claim 1 is not believed to come under the subjective "preference" referred to in MPEP 2173.05(d).

For these reasons, Applicants take the position that the rejection of the claims under 35 U.S.C. §112 should be withdrawn.

The patentability of the presently claimed invention over the disclosure of the reference relied upon by the Examiner in rejecting the claims will be apparent upon consideration of the following remarks.

Thus, the rejection of claims 1, 2 and 4 under 35 U.S.C. §102(b) as being anticipated by JP 8-158170 (JP '170), as well as the rejection of claims 5-9 under 35 U.S.C. §103(a) as being unpatentable over this reference, are respectfully traversed.

Initially, Applicants are enclosing a machine translation of the JP '170 reference.

Applicants note that this reference is discussed as Patent document 2 at page 2, lines 11 – 21 of the specification. As discussed there, JP '170 uses a mixture of a pitch-based carbon fiber with a natural fiber and/or a synthetic fiber, which requires a troublesome post-heating treatment for conversion of the natural or synthetic fiber into carbon fiber.

Even aside from this, JP '170 discloses a method for producing thin and flexible spun yarns from **short** pitch carbon fibers as shown at PURPOSE in the English abstract. Therefore, according to the JP '170 method, it is impossible to obtain a spun yarn of sufficient tensile strength, as discussed on page 2 of the specification. More specifically, at paragraph [0022] of JP '170, describing a sole working example of production, a mixture of carbon fiber having a fiber length of 30 – 50 mm and rayon fiber having a fiber length of 38 mm is used. In contrast thereto, the claimed process uses a pitch-based carbon fiber mat containing **at least 30 wt.% of carbon fibers having a fiber length of at least 100 mm.**

In JP '170, such a simple mixture of the two fibers is used as a starting material and is fed through a hopper feeder 10, a measuring device 12, a feed lattice 16 and a feed roller 18 to a take-in roller 20 of a carding apparatus. JP '170 does not disclose or suggest anything about preferential alignment in one direction of the pitch carbon fiber in the mixture with rayon to be fed to the carding machine.

In the claimed process, a carbon fiber mat comprising such long carbon fibers can be directly subjected to drawing and carding actions of the carding machine because the long carbon fibers in the mat are preferentially aligned in one direction, whereby effective production of a carbon fiber sliver composed of long carbon fibers and showing excellent properties can be achieved. This is impossible by the method of JP '170.

For these reasons, Applicants take the position that the presently claimed invention is clearly patentable over this reference.

Therefore, in view of the foregoing amendments and remarks, it is submitted that each of the grounds of rejection set forth by the Examiner has been overcome, and that the application is in condition for allowance. Such allowance is solicited.

The Commissioner is authorized to charge any deficiency or to credit any overpayment associated with this communication to Deposit Account No. 23-0975, with the EXCEPTION of deficiencies in fees for multiple dependent claims in new applications.

Respectfully submitted,

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(54) PRODUCTION OF SPUN YARN OF PITCH CARBON FIBER

(57)Abstract:

PURPOSE: To provide a method for producing thin and flexible spun yarns from short pitch carbon fibers.

CONSTITUTION: Pitch carbon fibers are blended with natural fibers and/or synthetic fibers, the mixture is made into fleece using a comb, then into sliver and the sliver is spun using an open-end spinning frame. In the combing process, the natural and/or synthetic fibers acts as a binder to relieve the damage to the carbon fiber and smoothen the movement of the fibers.

Thus, the fleece excellent in parallel degree of fibers is efficiently obtained. Since the sliver is spun with the open-end spinning frame, thus drafted and twisted without roller pressure, a thin and high-strength spun yarn is obtained without damaging the pitch carbon fibers.

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CLAIMS

[Claim(s)]

[Claim 1]A manufacturing method of pitch based carbon fiber cotton yarn characterized by comprising the following.

A process which it is considered as mixed cotton by mixing with cotton and opening a natural fiber and/or a synthetic fiber to a pitch based carbon fiber, and carries out weighing of the specified quantity and is supplied to a carding machine.

A process formed in a sliver after making into the shape of fleece said mixed cotton supplied using a carding machine.

A process of extending and carrying out twisting of said sliver, and carrying out spinning using an open-end spinning machine.

[Claim 2]A manufacturing method of the pitch based carbon fiber cotton yarn according to claim 1, wherein mixed wt. ratios of a pitch based carbon fiber of said mixed cotton, a natural fiber, and/or a synthetic fiber are 8:2-7:3.

[Claim 3]A manufacturing method of the pitch based carbon fiber cotton yarn according to claim 1 or 2, wherein converge said fleece-like mixing cotton and it faces considering it as a sliver, and holds a predetermined interval, and is supported pivotally and the roll side uses a calender roller of a couple covered with a spring material.

[Claim 4]A manufacturing method of the pitch based carbon fiber cotton yarn according to any one of claims 1 to 3 carrying out spinning of the predetermined interval using a delivery roller and a top roller which were held and supported pivotally in a process of extending and carrying out twisting of said sliver, and carrying out spinning using an open-end spinning machine.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the spinning method of the pitch based carbon fiber of a staple fiber.

[0002]

[Description of the Prior Art] Since strength and the elastic modulus of carbon fiber are high compared with the existing material, it is lightweight and it moreover excels in heat resistance, adiabaticity, and the friction characteristic, in the state of the filament, it is used for the use large as a fire refractory material, thermal insulation, a friction material, etc. in the state of textiles as a reinforcing member of a plastic. Carbon fiber is classified into a rayon system, a pan system, and a pitch system according to the manufacturing raw materials.

[0003] There is a thing of a staple fiber of 10 cm or less in a pitch based carbon fiber among these carbon fiber, and in order to use it for a friction material etc. by making the pitch based carbon fiber of this staple fiber into the shape of textiles, it is necessary to lengthen, arrange and carry out twisting of the textiles, and to consider it as cotton yarn. Usually, the manufacturing method of cotton yarn of staple fibers (staple), such as cotton, Open raw cotton with blowing and scutching machinery, and an abbreviated ***** sliver is obtained for textiles with a carding machine. Subsequently, in drawing frame, several slivers are extended several times and the parallelism of textiles is further improved as one sliver, extension twisting of the sliver is carried out in bobbin and fly frame, and it is considered as corded Shino, and with a fine spinning machine, extension twisting of this ** is carried out further, and cotton yarn is obtained.

[0004] However, the pitch based carbon fiber of this staple fiber, Since there is no curl in the textiles themselves, there is almost no tangle of textiles, and since there is little the upper frictional resistance, both textiles become scattering easily, It receives bending and is very weak, and since there is a fault of it being crashed and grinding when textiles are moreover inserted between the rollers to which weight was applied, the spinning method of the aforementioned staple fiber is inapplicable as it is.

[0005] Therefore, if spinning of the manufacturing method of the cotton yarn of a pitch based carbon fiber used from the former is carried out using the device shown in drawing 5 and the outline is explained, The raw cotton 54 opened by the opener 52 under the water spray is sent to the hopper feeder 10, weighing of the constant rate is carried out with the weighing machine 12, and the raw cotton 54 further opened with the hopper feeder 10 falls on the lattice 16. While being scratched by the taker-in roller 20 of the roller card 56 and being transported to the doffer 26 from the cylinder 22, it becomes the web 58 and the textiles of the raw cotton on the lattice 16 are taken out from ***** and the doffer 26 so that textiles may become parallel. The taken-out web 58 is divided into about 6-inch width by the diamond cutter 60, and by the capacitor 62, a temporary twist is added and it is rolled round by **** 64. Rolled-round ** becomes cheese head-like (spool), and subsequently, with a thread plying machine, real ** is added and it serves as thread.

[0006]

[Problem(s) to be Solved by the Invention] However, since the thread obtained by the conventional carded wool method like the above is what obtains thread with a thread plying machine promptly, without dividing the fleece obtained at a carding process and giving a draft, spinning of thin thread is difficult and thread of the thickness of 0.5 or less g/m cannot be spun. The characteristic of a pitch based carbon fiber breaks, flexural strength is very low, and it will be cut when textiles shift with the wire of the taker-in roller in a card - a cylinder - a doffer.

[0007] Since there will be no intensity and thread will cut if too thin when devising to a thread plying machine, where a false twist is applied by a capacitor part, spinning is impossible if it does not have the thickness more than fixed. Since there is no intensity of the thread with which the parallelism of textiles was bad and was moreover done since it was only what only divided fleece, use with single yarn cannot be performed, but it becomes what has a diameter of thread throwing which twisted 2-3 single yarn is required, and thick, and a use is limited.

[0008] This invention was made in order to solve the problem like the above of the manufacturing method of the cotton yarn which consists of a pitch based carbon fiber of a staple fiber, and it is ****. In order to use the purpose as a textiles-like friction material, thermal insulation, etc., it is thin, and intensity is high, and composite with other raw materials is providing the manufacturing method of the pitch based carbon fiber cotton yarn which can spin easy thread in a post process.

[0009]

[Means for Solving the Problem] Artificers adopt a spinning method which omits a drawing process and a rough elaborate degree, and carries out spinning of the sliver after passing through a carding process with a spinning process promptly based on the characteristic of a pitch based carbon fiber, and. Damage to a pitch based carbon fiber was stopped to the minimum, and while carrying out the draft of the sliver, examination was wholeheartedly repeated about a manufacturing method which can carry out twisting. As a result, a thing for which these natural fibers and/or a synthetic fiber will tie in a carding process, it will act as textiles, and breakage of carbon fiber will be eased if a natural fiber and/or a synthetic fiber are mixed with cotton to a pitch based carbon fiber, And by carrying out spinning of the sliver obtained at a carding process with an open-end spinning machine, the knowledge of a draft and twisting of a sliver being possible was newly carried out, and this invention was completed.

[0010] A manufacturing method of pitch based carbon fiber cotton yarn of claim 1 of this invention, A process which it is considered as mixed cotton by mixing with cotton and opening a natural fiber and/or a synthetic fiber to a pitch based carbon fiber, and carries out weighing of the specified quantity and is supplied to a carding machine, Let it be a gist to consist of a process formed in a sliver after making into the shape of fleece said mixed cotton supplied using a carding machine, and a process of extending and carrying out twisting of said sliver, and carrying out spinning using an open-end spinning machine. A manufacturing method of pitch based carbon fiber cotton yarn of claim 2 of this invention makes it a gist for mixed wt. ratios of a pitch based carbon fiber of said mixed cotton, a natural fiber, and/or a synthetic fiber to be 8:2-7:3 in an invention of a manufacturing method of claim 1.

[0011] A manufacturing method of pitch based carbon fiber cotton yarn of claim 3 of this invention, In an invention of a manufacturing method of claim 1 or claim 2, said fleece-like mixing cotton is converged and it faces considering it as a sliver, and a predetermined interval is held, and it is supported pivotally, and let it be a gist for the roll side to use a calender roller of a couple covered with a spring material. A manufacturing method of pitch based carbon fiber cotton yarn of claim 4 of this invention, Let it be a gist to carry out spinning of the predetermined interval using a delivery roller and a top roller which were held and supported pivotally in an invention of a manufacturing method of claim 1 thru/or claim 3 in a process of extending and carrying out twisting of said sliver, and carrying out spinning using an open-end spinning machine.

[0012] Cotton, wool, hemp, etc. can be used for a natural fiber which mixes with cotton to a pitch based carbon fiber, for example. As a synthetic fiber, rayon, polyester, an acrylic, etc. can be used, for example. A natural fiber or a synthetic fiber is independent, or it can mix and it can mix

with cotton.

[0013]A flat card or a roller card can also use all for a carding machine used at a carding process. A publicly known pot fine spinning machine is used for an open-end spinning machine which carries out spinning of the sliver from the former. However, there is no draft part in a fine spinning machine used for this invention, and a sliver is directly supplied to a rotor through a combing roller.

[0014]

[Function]In the manufacturing method of pitch based carbon fiber cotton yarn of this invention, Since it is considered as mixed cotton by a natural fiber and/or a synthetic fiber mixing with cotton to a pitch based carbon fiber, and opening to it, and weighing of the specified quantity is carried out and a carding machine is supplied, In while these natural fibers and/or a synthetic fiber tie in a carding process, and it acts as textiles, and this mixed cotton is scratched with the needle of a taker-in roller, shifts to the needle of a cylinder and the needle of a ***** doffer is won popularity and passed, Breakage of carbon fiber is eased and shift of textiles is performed smoothly. Therefore, the fleece which was excellent in the parallelism of textiles is obtained efficiently, and this fleece-like mixing cotton is formed in a sliver.

[0015]It is desirable to set the mixed wt. ratio of a pitch based carbon fiber, a natural fiber, and/or a synthetic fiber to 8:2-7:3 in this invention. It is because the effect as bond textiles cannot be expected that the mixed weight ratio of a natural fiber and/or a synthetic fiber which mixes with cotton to a pitch based carbon fiber is less than 20%, and is because the characteristic of a pitch based carbon fiber will deteriorate if 30% is exceeded.

[0016]It is desirable to use the calender roller of the couple which covered the roll side with the spring material, and held the predetermined interval, and was supported pivotally for the calender roller of the carding machine which converges fleece-like mixing cotton and carries out delivery as a sliver. By converging fleece using this calender roller and considering it as a sliver, damage to the pitch based carbon fiber by a calender roller is avoided. As for the gap between calender rollers, it is preferred to be referred to as 0.5-1.5 mm. It is because convergence of fleece and the delivery of a sliver become impossible to satisfaction when there is a possibility of damaging a pitch based carbon fiber as a gap is less than 0.5 mm and 1.5 mm is exceeded.

[0017]Since spinning of the obtained sliver is carried out by an open-end spinning machine, without receiving application of pressure with a roller, a draft is carried out, twisting is carried out, and the cotton yarn which was thin and was excellent in intensity can be obtained, without damaging a pitch based carbon fiber. In an open-end spinning machine, it is preferred to carry out spinning of the predetermined interval to the delivery roller and top roller which pull out cotton yarn from a rotor using the delivery roller and top roller which were held and supported pivotally. By carrying out spinning using this delivery roller and top roller, damage to the pitch based carbon fiber in cotton yarn is prevented. As for the interval of a delivery roller and a top roller, it is preferred to be referred to as 2-4 mm. It is because it will become impossible to pull out thread from a rotor if there is a possibility that a pitch based carbon fiber may be damaged as this interval is less than 2 mm and 4 mm is exceeded.

[0018]

[Example]The example of this invention is described according to a drawing below. Drawing 1 is an outline side view of the device used for the cotton-mixing process and carding process of this invention. A cotton-mixing process consists of the hopper feeder 10 and the weighing instrument 12, its hopper feeder 10 is run through its mixed cotton 14 mixed with cotton and opened by the spiked lattice, and it is supplied to the weighing instrument 12, and if a constant rate is reached, it will be sent to the following carding process.

[0019]The carding machine used for the following carding process, The mixed cotton 14. The feed roller 18 which supplies the mixed cotton on the feeding lattice 16 and the feeding lattice 16 to supply to the taker-in roller 20, the taker-in roller 20 which is scratched by the serration in which it rotated at high speed and the mixed cotton from the feed roller 18 was implanted by the surface, and is passed to the cylinder 22, and by rotating. Receive with the needle in which the textiles of the taker-in roller 20 were implanted by the surface according to the difference of surface velocity with the taker-in roller 20, and textiles between war Corolla 24 The *****

cylinder 22, The calender roller 32 which converges the mixed cotton 28 of the shape of fleece taken out from the doffer 26 which receives ***** textiles from the cylinder 22 and is taken out as the shape of fleece, and the doffer 26, and forms the sliver 30 is comprised.

[0020]The side view of the calender roller 32 is as being shown in drawing 2, and it is covered with the spring material 34 which consists of urethane, rubber, etc. by the roll side, and the predetermined interval A is held and it is supported pivotally.

[0021]Drawing 3 is an outline side view of the device used for the spinning process. The sliver 30 formed of the carding process is supplied to the rotor 38 with ***** by the combing roller 36. The rotor 38 sticks to a wall and rotates the supplied sliver at high speed. On the other hand, it is inserted into the delivery roller 44 and the top roller 46 which the cotton yarn 42 rotates through the yarn guide pipe 40, and is taken out from the rotor 38. The taken-out cotton yarn 42 is rolled round by the winding rollers 48, and serves as the cheese head 50. The sectional view of the delivery roller 44 and the top roller 46 is as being shown in drawing 4, and the interval B is established between the delivery roller 44 and the top roller 46.

[0022]Next, pitch based carbon fiber cotton yarn was manufactured by this invention method using the device shown in drawing 1 - drawing 4. A pitch based carbon fiber (the Osaka Gas Co., Ltd. make, trade name Donna S, 30-50 mm of fiber length) to the hopper feeder 10 shown in drawing 1 First, 80 % of the weight, The mixed cotton 14 which supplied 20 % of the weight, mixed with cotton and opened rayon (the Toho Rayon Co., Ltd. make, 1.5 deniers, 38 mm of fiber length) was supplied to the weighing instrument 12 from the hopper feeder 10, and the mixed cotton 14 which carried out constant-rate [every] weighing was supplied on the feeding lattice 16 of a carding machine.

[0023]The mixed cotton 14 supplied on the feeding lattice 16, It was hooked on the needle tip of the taker-in roller 20 which carries out a high velocity revolution by the feed roller 18, and subsequently to the needle of the cylinder 22 shifted, ***** textiles were arranged in parallel between war Corolla 24, the doffer 26 was won popularity and passed, and it became the fleece-like mixing cotton 28, and was taken out from the doffer 26. It converged this fleece-like mixing cotton with the calender roller 32, and the sliver 30 was formed. The interval A of the calender roller 32 was set as 1 mm, and obtained the sliver. At this time, the weight of the obtained sliver 30 was 1.8g/m.

[0024]Spinning of this sliver 30 was carried out using the open-end spinning machine shown in drawing 3 with 18 times as many drafts and 500 number of twists/m, and No. 10 count (1/10, a display, and 0.1g/(m)) cotton yarn was obtained with the meter yarn count. The spinning conditions at this time considered the number of rotations of the combing roller for the number of rotations of the rotor 38 as a part for /3000 times by /20000 times. Spinning of the interval B of the delivery roller 44 and the top roller 46 was set up and carried out to 3 mm.

[0025]Eight No. 10 count thread obtained by this example was twisted, 70 twists/m were added, and it was considered as the string of 0.8 g/m. 70 twists/m were added for one pure copper line of 8 ** and 0.32 mmphi, or 4-6 pure copper lines of 0.16 mmphi, and the No. 10 count thread similarly obtained by this example was used as the string. Any string was able to use it as a string useful as a substrate of a friction material.

[0026]

[Effect of the Invention]As explained in full detail above, the manufacturing method of pitch based carbon fiber cotton yarn of this invention, **** a natural fiber and/or a synthetic fiber to a pitch based carbon fiber, and it forms in a sliver, after making this mixed cotton into the shape of fleece using a carding machine, Spinning of the obtained sliver is carried out using an open-end spinning machine, in a carding process, these natural fibers and/or a synthetic fiber tie, and it acts as textiles, and breakage of carbon fiber is eased and shift of textiles is performed smoothly. Therefore, the fleece which was excellent in the parallelism of textiles is obtained efficiently. Since spinning of the obtained sliver is carried out by an open-end spinning machine, without receiving application of pressure with a roller, a draft is carried out, twisting is carried out, and the cotton yarn which was thin and was excellent in intensity can be obtained, without damaging a pitch based carbon fiber. Since the roll side was covered with the spring material to the calender roller of the carding machine which converges fleece-like mixing cotton and carries

out delivery as a sliver and the predetermined interval was held to it, damage to the pitch based carbon fiber by a calender roller is avoided. In an open-end spinning machine, damage to the pitch based carbon fiber in cotton yarn is prevented by carrying out spinning of the predetermined interval to the delivery roller and top roller which pull out cotton yarn from a rotor using the delivery roller and top roller which were held and supported pivotally.

[Translation done.]